

Ecological site R062XA010SD Loamy - North

Accessed: 05/17/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

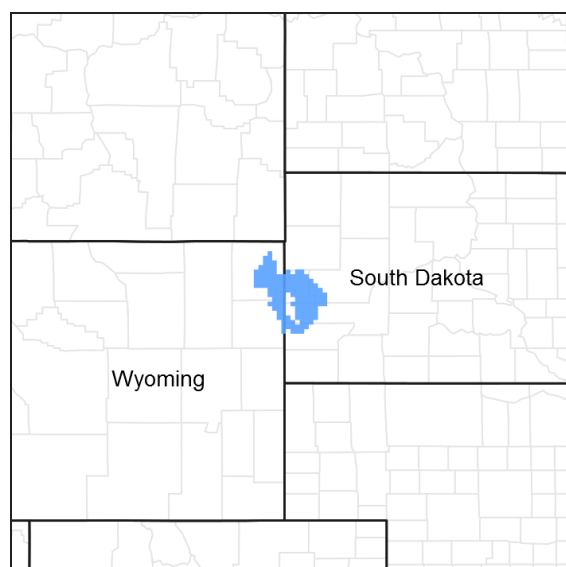


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 062X–Black Hills

The Black Hills, MLRA 62, is a unique, low lying mountain range situated in the midst of a mixed short to mid-grass prairie. It has geophysical and Biological attributes that are unlike the surrounding area. The Black Hills Foothills, MLRA 61, is a transition zone that essentially rings the Black Hills. MLRA 62 is approximately 3,040 square miles in size, 74 percent of which is located in South Dakota and 26 percent in Wyoming.

Classification relationships

LRR: Western Great Plains Range and Irrigated Region, MLRA: 62 - Black Hills, LRU: A - 22-30 PZ, Central Crystalline, Low Limestone and Siltstone Plateau and Bear Lodge Mountains. The elevation range in LRU-A is 3,800 to 6,200 feet above sea level.

Level IV Ecoregions of Conterminous United States, 2013: 17b Black Hills Plateau.

Ecological site concept

The site is located on upland landscapes or old stream terraces within the northern portion of the Black Hills (LRU-A). The soils are loamy with a surface layer thickness less than 15 inches in depth. They are well drained without a restrictive layer that impedes water movement or rooting depth. Most soils on this site have calcium carbonates in

the profile but are typically located at 12 inches or greater below the surface. It does not receive additional water from runoff or overflow. The typical slope range is from 0 to 15 percent. Vegetation in reference consists of both cool (dominate) and warm season grass species. Cool season grasses include western and bearded wheatgrass, porcupine grass, green needlegrass, and Richardson's and Columbia needlegrass. Warm season grasses include big bluestem, little bluestem, and prairie dropseed. Forbs are common and diverse but never dominant, and shrubs such as western snowberry and leadplant are often present in plant community. This site is susceptible to pine encroachment from adjacent sites.

Associated sites

R062XA020SD	Loamy Overflow - North The Loamy Overflow site can be located adjacent to the Loamy site however it is directly influenced by additional water.
R062XA024SD	Shallow Loamy - North The Shallow Loamy site is commonly associated with the Loamy site but is located on steeper slopes with shallow soil depths.

Similar sites

R062XY043SD	Valley Loam The Valley Loam site typically has a deeper and darker soil profile, more big bluestem and higher production.
R062XA020SD	Loamy Overflow - North The Loamy Overflow site will have more big bluestem and higher production.
R062XA011SD	Clayey - North The Clayey site will support more green needlegrass and less needleandthread and big bluestem. Snowberry is not common on the Clayey site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Pascopyrum smithii</i> (2) <i>Hesperostipa comata</i>

Physiographic features

This site occurs on nearly level to sloping footslopes and backslopes in the Black Hills.

Table 2. Representative physiographic features

Landforms	(1) Fan (2) Terrace (3) Mountain slope
Elevation	1,158–1,890 m
Slope	0–25%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 62 is in a microclimate caused by the influence of increased elevation which leads to increased precipitation, moderate air temperature, and lower wind velocities as compared to the surrounding Great Plains. In general, the Black Hills climate is a continental type, cold in the winter and hot in the summer. Annual precipitation in MLRA 62 typically increases with elevation and decreases from west to east and north to south. The average annual

precipitation range for LRU-A (North) is 22 to 30 inches. Most of the rainfall occurs as frontal storms early in the growing season, May and June. Some high-intensity, convective thunderstorms occur in July and August. Precipitation in the winter occurs mostly as snow. The annual average snowfall ranges from 23 inches at the lower elevations in the south to 54 inches at the higher elevations in the central part of MLRA 62. Average annual temperature ranges from 36 to 48 degrees F. January is the coldest month, with an average temperature of 22 °F in the central part and 25 °F in the southern part of MLRA 62. July is the warmest month, with an average daily temperature of 67 °F in the central part and 73 °F in the southern part of this MLRA. The frost free period ranges from 129 to 168 days. It is shortest at higher elevations and in the northwestern part of the MLRA. Hourly winds are estimated to average about 11 miles per hour (mph) annually. Growth of cool-season plants begins in April, slowing or ceasing growth by Mid-August. Warm-season plants begin growth in May, and continue to Mid-September. Regrowth of cool-season plants may occur in September and October depending on soil moisture availability.

Table 3. Representative climatic features

Frost-free period (average)	107 days
Freeze-free period (average)	130 days
Precipitation total (average)	635 mm

Climate stations used

- (1) LEAD [USC00394834], Lead, SD
- (2) MT RUSHMORE NATL MEM [USC00395870], Keystone, SD
- (3) PACTOLA DAM [USC00396427], Rapid City, SD

Influencing water features

This site occurs on upland or terrace landscapes and is not influenced by extra water from streams or wetlands.

Soil features

The soils on this site are moderately deep to very deep and well drained. The surface layer is at least 5 to 6 inches thick, and may range up to 20 inches thick. Surface textures are loamy (specific textures are listed below). Most of the soils have calcium carbonate in the profile, but they are leached to depths typically greater than 12 inches. Slopes are typically 0 to 15 percent, but range up to 25 percent in a few instances.

Water erosion is the primary hazard on this site. Erosion is normally minimal on slopes less than 6 percent, and occurs primarily in the form of sheet erosion when present. Sheet and rill erosion can occur on linear surfaces where slopes range from 6 to about 10 percent. On non-linear (undulating) surfaces, rill erosion is dominant. On slopes greater than about 10 percent, rill erosion can be present on all types of surfaces. Rill erosion can often morph into gully erosion in areas where flow paths concentrate into one on disturbed sites. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and/or production. Although the soils on this site are not normally susceptible to significant wind erosion, site disturbances can increase the hazard locally.

The commonly-occurring soils for this site include Bullflat, Gurney, Norkool, Reicess, and Sugakool. Most of these soils occur in both LRU A and C.

Access Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/>) for specific local soils information.

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone and sandstone
Surface texture	(1) Loam (2) Silt loam
Family particle size	(1) Loamy

Drainage class	Well drained
Permeability class	Moderately slow to moderate
Soil depth	51–152 cm
Surface fragment cover <=3"	0–3%
Surface fragment cover >3"	0–1%
Available water capacity (0-101.6cm)	7.62–30.48 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–3
Soil reaction (1:1 water) (0-101.6cm)	5.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–25%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

Black Hills vegetation types consist of a mixture of forest and grasslands resulting from the varied topography, geology, soils, climate and natural disturbances. Frequent fires, periodic drought, and episodic mountain pine beetle infestations all contribute to the maintenance of large open grasslands scattered throughout the Black Hills. Ponderosa pine is the dominant tree species in the Black Hills. It is a fire adapted species that coexists with frequent, low-intensity fires that consume small seedlings, prune lower branches from larger trees, and reduce fuel loads on the forest floor.

This site developed under Black Hills climatic conditions with short-term weather variations, light to severe grazing by bison, elk and small mammals, sporadic natural or man-caused wildfire (often of light intensities), and other biotic and abiotic factors that typically influence soil/site development. The natural fire regime maintained this site as a grassland and the plant communities were free of non-native cool season grasses.

Fire, or the lack of fire, and introduced non-native cool season grasses, are major drivers, along with grazing that shape this site as well as adjacent ecological sites. Between 1388 and 1900, fire intervals in the Black Hills ranged from 16 to 20 years (Brown and Hull-Sieg, 1996). In the absence of fire, encroachment of ponderosa pine is likely to occur on this site. The Loamy ecological site is not as susceptible to encroachment as the Shallow Loamy site but because they typically adjoin, encroachment can occur and untreated, pine will become established. Competition with cool season dominated grasses on the Loamy site hinder establishment of pine seedlings, whereas the gravelly and stony soils on the Shallow Loamy site typically dominated by warm season grasses do not provide that direct competition early in the growing season.

Kentucky bluegrass, smooth brome and timothy are common cool season grass species throughout MLRA 62. Because the Black Hills have higher precipitation amounts and cooler spring and fall periods these non-native cool season grasses can easily become established in a plant community. Improper grazing management, and non-use and/or no fire can cause these species to increase and become the dominant species in a plant community. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant animal and insect species, grazing management, and severe disturbances, such as periods of well-below average precipitation, severe defoliation, excessive haying or no fire and no use.

The Reference State is difficult to locate in this LRU with the introduction of non-native cool season grasses. Plant community phase 2.1 is most similar to the Reference State but because of the persistence of non-native cool season grasses a restoration pathway to the Reference State is not believed to be achievable.

The following diagram illustrates the common plant community phases that can occur on the site and the transition pathways between communities. These are the most common plant community phases based on current knowledge and experience, and changes will be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model

Loamy – 062XA010SD LRU-A (North) 8/13/15

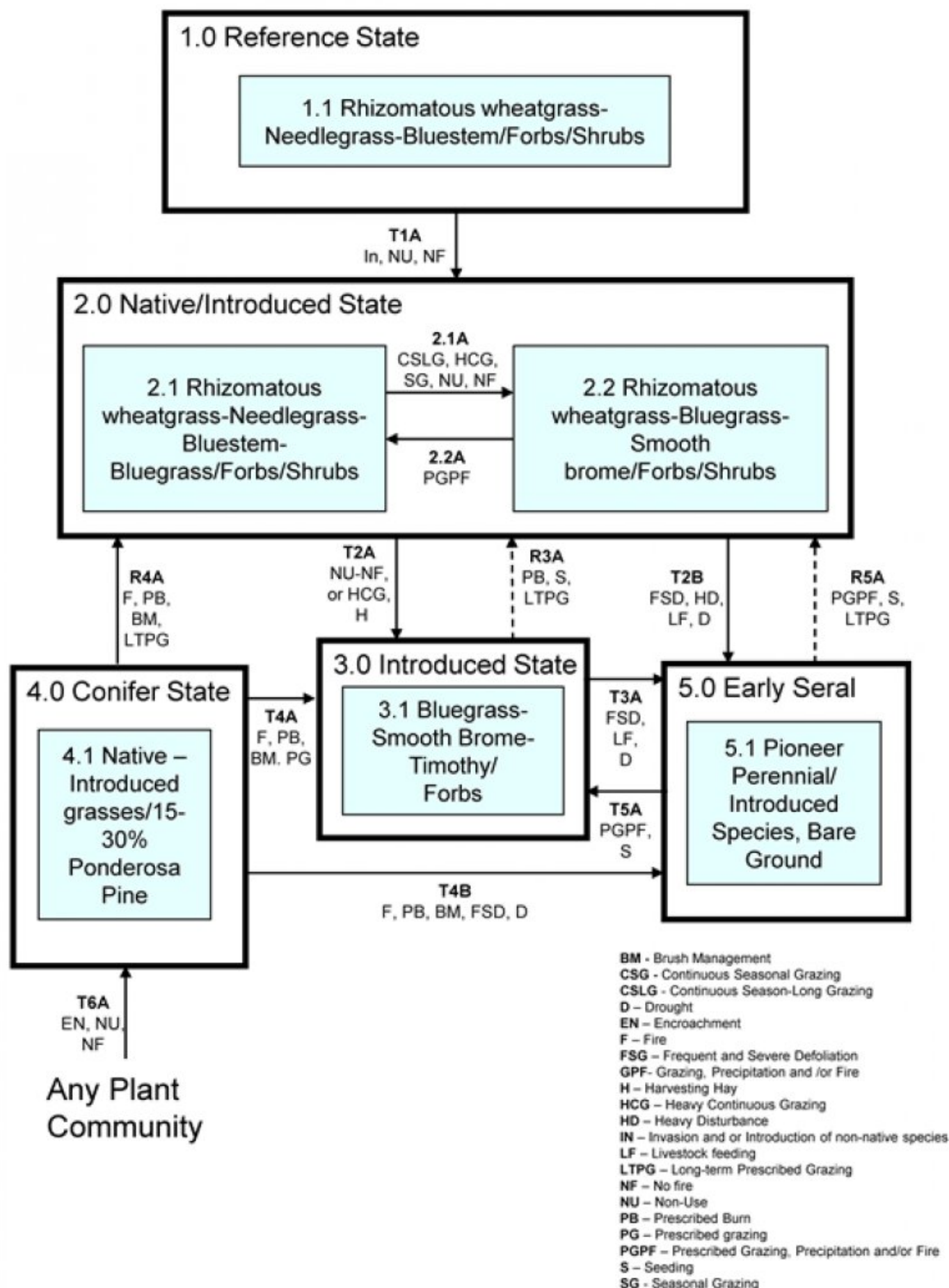


Figure 6. Loamy - 062XA010SD

Diagram Legend - Loamy - LRU-A - 062XA010SD		
T1A	Introduction of non native cool season grasses, no use and no fire	
T2A	No use and no fire, or heavy continuous grazing or excessive haying	
T2B	Frequent and sever defoliation, heavy disturbance, livestock feeding area, drought	
T3A	Frequent and sever defoliation, livestock feeding area, drought	
T4A	Fire, prescribed burning, mechanical brush management followed with prescribed grazing	
T4B	Fire, prescribed burning, mechanical brush management, frequent and fever defoliation, drought	
T5A	Prescribed grazing, normal precipitation pattern and/or normal fire regime and seeding	
T6A	Encroachment of conifers, no use and no fire	
R3A	Prescribed burning, seeding followed with long tern prescribed grazing	
R4A	Fire, prescribed burning, mechanical brush management followed with long term prescribed grazing	
R5A	Prescribed grazing, normal precipitation pattern and/or normal fire regime, seeding and long term prescribed grazing	
2.1A	2.1-2.2	Non-use and no fire and/or continuous season long grazing or seasonal grazing occurring at the same time every year or heavy continuous grazing
2.2A	2.2-2.1	Prescribed grazing that provided adequate recovery and change in season of use, normal precipitation regime and fire reducing the percent of non-native cool season grasses and restoring the tall warm season component

Figure 7. Loamy - 062XA010SD

State 1 Reference

This state represents what is believed to represent the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. The Reference State is unlikely to occur with the introduction of non-native cool season grasses which are common throughout the MLRA. This site was dominated by cool and warm season grasses. In pre-European times the primary disturbances included fire, insects and grazing by large ungulates and small mammals. Favorable growing conditions occurred during the spring, and warm months of June and July. Routine and/or occasional fires, reduced tree cover and contributed to the ecological processes that maintained the reference plant community.

Community 1.1 Rhizomatous wheatgrass-Needlegrass-Bluestem/Forb/Shrub



Figure 8. Loamy North 062XA010SD PCP-1.1

Interpretations are based primarily on the Rhizomatous wheatgrass-Needlegrass-Bluestem/Forb/Shrub plant community phase. This is also considered to be the reference or historic plant community. The potential vegetation is about 75 percent grass and grass-like plants, 15 percent forbs, 10 percent shrubs and 0 to 2 percent trees. Total

annual production for a normal growing year is approximately 2,500 lbs. /Ac. The community is dominated by cool-season grasses and tall and mid-height warm season grasses. The dominant cool season grasses include western and bearded wheatgrass, porcupine grass, green needlegrass, Richardson's needlegrass and Columbia needlegrass. Dominant warm season grasses are big bluestem, little bluestem, and prairie dropseed. Other grasses include sideoats grama, slender wheatgrass, and Richardson's sedge. The dominant shrub is western snowberry, leadplant and rose. This plant community was productive and resilient to disturbances such as drought and fire. It was a sustainable plant community in regards to soil/site stability, watershed function, and biological integrity.

State 2

Native/Introduced

This state represents what is most typically found on this site. The natural range of variability is influenced by the presence of non-native cool season grasses, especially Kentucky bluegrass and smooth brome that can dominate the dynamics of this ecological site. Proper grazing management and periodic burning will maintain the productivity of this state. Heavy grazing without adequate recovery, extended periods of drought or non-use and no fire can put this state at risk of crossing a threshold.

Community 2.1

Rhizomatous wheatgrass-Needlegrass-Bluestem-Bluegrass/Forbs/Shrubs

This plant community phase closely resembles the PCP 1.1 however non-native cool season grasses have invaded the site and under the current Black Hills climatic conditions will persist in the plant community. The potential vegetation is about 75 percent grass and grass-like plants, 15 percent forbs, 10 percent shrubs and 0 to 2 percent trees. Total annual production for a normal growing year is approximately 2,400 lbs. /Ac. The community is dominated by cool-season grasses and tall and mid-height warm season grasses. The dominant cool season grasses include western and bearded wheatgrass, Richardson's and green needlegrass and porcupine grass. Kentucky bluegrass and/or other non-native cool season grasses can make up 2 to 5 percent of the plant community. Dominant warm season grasses are big bluestem, little bluestem, and prairie dropseed. Other grasses include sideoats grama, tall dropseed, slender wheatgrass, and Richardson's sedge. The dominant shrub is western snowberry, leadplant and rose. This plant community is productive and resilient to disturbances such as drought and fire. It was a sustainable plant community in regards to soil/site stability, watershed function, and biological integrity. Management strategies must include techniques that will not cause Kentucky bluegrass and other non-native cool season grasses to increase significantly as this could put the plant community at risk of transition to the Introduced/Invaded State.

Community 2.2

Rhizomatous wheatgrass-Bluegrass-Smooth brome/Forbs/Shrub

This plant community evolved under continuous season-long grazing, seasonal grazing with no change in season of use or no use and no fire or heavy continuous grazing. This plant community phase is made up of approximately 85 percent grass and grass-like plants, 10 percent forbs, 5 percent shrubs and 0 to 2 percent trees. The community is dominated by cool-season grasses, with most of the warm season grass component being replaced by Kentucky bluegrass and other non-native cool season grasses. The dominant cool season grasses include western and bearded wheatgrass, porcupine grass and Richardson's needlegrass. Kentucky bluegrass or other non-native cool season grasses can make up 10 to 25 percent of the plant community. This plant community is at-risk of crossing a threshold to the Introduced State.

Pathway 1A

Community 2.1 to 2.2

Non-use and no fire and/or continuous season long grazing or seasonal grazing occurring at the same time every year or heavy continuous grazing will cause an increase in non-native cool season grass species moving this plant community to PCP 2.2.

Pathway 2A

Community 2.2 to 2.1

Prescribed grazing that provides adequate recovery and change in season of use, along with normal precipitation regime and fire may reduce the percent of non-native cool season grasses in PCP 2.2 and restore the tall warm season component typical of PCP 2.1.

State 3

Introduced/Invaded

This state is the result of invasion and dominance of introduced species. This state is characterized by the dominance of Kentucky bluegrass and smooth brome, and an increasing thatch layer that effectively blocks introduction of other plants into the system. Plant litter accumulation tends to favor the more shade tolerant introduced grass species. The nutrient cycle is also impaired, and the result is typically a higher level of nitrogen which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns thereby shifting competitive advantage to shade tolerant introduced grass species. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the invasive grass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition. Plant communities dominated by Kentucky bluegrass have significantly less cover and diversity of native grasses and forb species. (Toledo, D. et al., 2014). Once the state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch will not result in more than a very short term reduction of Kentucky bluegrass. These events may reduce the dominance of Kentucky bluegrass, but due to the large amount of rhizomes in the soil there is no opportunity for the native species to establish and dominate before Kentucky bluegrass rebounds and again dominates the system.

Community 3.1

Kentucky bluegrass-Smooth brome-Timothy/Forb

This plant community is dominated by Kentucky bluegrass and/or other non-native cool season grasses (30 percent or more of the PC). This plant community evolved under no use and no fire or with heavy continuous season-long grazing, or seasonal grazing with no change in season of use or excessive haying. This plant community is made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs. Dominant grasses include Kentucky bluegrass, smooth brome, and timothy. Western wheatgrass and some needlegrass may still be found in the plant community. Forbs commonly found in this plant community include cudweed sagewort, goldenrod, scurfpea, and western ragweed. Production will be significantly reduced when compared to the interpretive plant community. The period when palatability is high is relatively short, as Kentucky bluegrass matures rapidly. Energy capture is also reduced. Runoff is high and biological activity in the soil is likely reduced significantly in this phase.

State 4

Conifer

This state is greatly influenced by conifers, primarily ponderosa pine but rocky mountain juniper can also be present. Ponderosa pine canopy was found to significantly reduce precipitation reaching the forest floor by an average of 30 percent due to interception in area of intermediate and dense canopy (Wrage, 1994). This state will develop when conifers encroach onto the site from adjacent forest sites or ecological sites that have been invaded. Encroachment and the establishment of conifers on this site is primarily the result of no fire and grazing management that reduced the competitive nature of the native herbaceous plant community. Once conifers become established on this site, non-native cool season grasses will increase especially in the shaded areas.

Community 4.1

Native/Introduced grasses/15-30% cover of Ponderosa pine

This plant community phase is the result of no use and no fire or on site that have had heavy continuous grazing resulting in increased bare ground where pine seedlings can become established. The potential vegetation is approximately 70 percent grasses and grass-like plants, 5 percent forbs, 5 -10 percent shrubs and up to 30 percent conifers. The majority of grasses will be cool season species with Kentucky bluegrass increasing because of its shade tolerance.

State 5

Early Seral

This state is the result of very heavy, concentrated disturbance such as cropping, concentrated rodent activity, or concentrated livestock areas. This state can develop as a result of invasion by highly competitive weed species such as Canada thistle, hound's tongue, leafy spurge, or knapweeds. Extended periods of drought accompanied by heavy grazing can also push an at risk plant community phase to this state. In most cases, this phase is dominated by annual and/or pioneer perennial species. Bare ground is also typically much higher than on any other plant community phase.

Community 5.1

Pioneer Perennial/Introduced Species/Bare ground

This plant community developed under continuous heavy grazing or heavy disturbances such as heavy use areas, abandoned cropland, and livestock feeding areas. The potential plant community is made up of 60-80 percent grasses and grass-like species, 15 to 35 percent forbs, 2 to 5 percent shrubs, 0-10. Percent bare ground can be very high in this plant community. The dominant grass is often Kentucky bluegrass. Other grasses may include annual brome grass (field brome and cheatgrass), sedge, sand dropseed, and western wheatgrass. The dominant forbs include fetid marigold, sweetclover, western ragweed, cudweed sagewort, and other invader-like species. The dominant shrubs include fringed sagewort, broom snakeweed. A wide variety of other early seral plant species can occupy this site in varying amounts. This plant community is susceptible to invasion of Canada thistle and other non-native species because of the relatively high percent of bare ground.

Transition 1A

State 1 to 2

Invasion and/or encroachment of non-native grasses such as Kentucky bluegrass, smooth brome and timothy, and disruption of natural disturbance regimes, typically as a result of fire suppression following settlement led this state over a threshold to the Native/Introduced State 2.0.

Transition 2A

State 2 to 3

Introduction or invasion of non-native cool season grass species. Non-use and no fire. Excessive haying of native grass species and or heavy continuous grazing. This transition is most likely going to occur from PCP 2.2

Transition 6A

State 2 to 4

Encroachment and establishment of conifer trees into this state due to no-use and no fire can cause a transition to the Conifer State.

Transition 2B

State 2 to 5

Severe and frequent defoliation which can be exacerbated by drought and/or additional livestock or wildlife use. Heavy use areas and livestock feeding areas can also cause this transition.

Restoration pathway 3A

State 3 to 2

Early season prescribed burning followed by long term prescribed grazing to promote establishment of native species. Chemical and/or mechanical treatment followed by seeding of native species may accelerate the reestablishment of structural functional groups similar to PCP 2.1 however the resulting plant community may not achieve management goals. This restoration pathway can take many years and in the end may not be successful.

Transition 6A

State 3 to 4

Encroachment and establishment of conifer trees into this state due to no-use and no fire can cause a transition to the Conifer State.

Transition 3A

State 3 to 5

Severe and frequent defoliation which can be exacerbated by drought and/or additional livestock or wildlife use will push this plan community to the Early Seral State.

Restoration pathway 4A

State 4 to 2

Reintroduction of fire or prescribed burning and/or, mechanical brush management to remove encroachment, followed by long term prescribed grazing to promote reestablishment of native species may accelerated the reestablishment of structural/functional groups similar to PCP 2.1 however the resulting plant community may not achieve management goals.

Transition 4A

State 4 to 3

Wild fire or prescribed burning or brush management to remove conifer encroachment followed by prescribed grazing management will transition back to the Introduced State.

Transition 4B

State 4 to 5

Wild fire, prescribed burn or brush management will treat conifer encroachment on this site but without proper grazing management this state will transition back to the Early Seral State.

Restoration pathway 5A

State 5 to 2

Removal of severe grazing disturbance (frequency and intensity), normal precipitation and fire regime, and time. Chemical and/or mechanical treatment followed by seeding of native species may accelerate the reestablishment of structural/functional groups similar to PCP 2.1 however the resulting plant community may not achieve management goals. This restoration pathway can take many years and in the end may not be successful.

Transition 5A

State 5 to 3

Removal of severe grazing disturbance (frequency and intensity), normal precipitation regime. Chemical and/or mechanical treatment followed by seeding of native and introduced species.

Transition 6A

State 5 to 4

Encroachment and establishment of conifer trees into this state due to no-use and no fire can cause a transition to the Conifer State.

Additional community tables

Other information

Revision Notes:

“This PROVISIONAL ecological site concept has been QC'd and QA'd to ensure that the site meets the NESH standards for a provisional ecological site that provides basic compiled information in one location. This site should not be considered an Approved ESD, as it is only the foundational site concepts and requires further data collection—specifically high-intensity data characterizations and full 232 soil descriptions—and further site investigations and final STM reviews before it can be used as an Approved ESD meeting NESH standards.”

Site Development and Testing Plan:

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Lakhdar Benkobi, ESI/SRIC, NRCS; Stan Boltz, Range Management Specialist, NRCS; Dan Brady, Soil Scientist, NRCS; Mitch Faulkner, Range Management Specialist, NRCS; Roger Gates, Associate Professor/Rangeland Management Specialist, West River Ag Center; Rick Peterson, Ecological Site Specialist, NRCS; Matthew, Scott, Botanist - USFS Hell Canyon District Ranger; L. Michael Stirling, Range Management Specialist, NRCS; Jim Westerman, Soil Scientist, NRCS.

Other references

Brown, P. M. and C. H. Sieg. 1996. Fire History in Interior Ponderosa Pine Communities of the Black Hills, South Dakota, USA, *Int. J. Wildland Fire* 6(3): 97-105.

High Plains Regional Climate Center, University of Nebraska, 830728 Chase Hall, Lincoln, NE 68583-0728. (<http://www.hprcc.unl.edu/>)

Toledo, D., Sanderson, M., Spaeth, K., Hendrickson, J., Printz, J. 2014. Extent of Kentucky Bluegrass and Its Effect on Native Plant Species Diversity and Ecosystem Services in the Northern Great Plains of the United States. *Invasive Plant Science and Management*. 7(4):543-522. Weed Science Society of America.

USDA, NRCS. National Water and Climate Center, 101 SW Main, Suite 1600, Portland, OR 97204-3224. (<http://wcc.nrcs.usda.gov>)

USDA, NRCS. National Range and Pasture Handbook, September 1997

USDA, NRCS. National Soil Information System, Information Technology Center, 2150 Centre Avenue, Building A, Fort Collins, CO 80526. (<http://nasis.nrcs.usda.gov>)

USDA, NRCS. 2001. The PLANTS Database, Version 3.1 (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

USDA, NRCS. National Ecological Site Handbook, 1st Ed, January 2014

Wrage, K. J. 1994. The effects of ponderosa pine on soil moisture, precipitation, and understory vegetation in the Black Hills of South Dakota. 158 p. Thesis.

Contributors

Peterson Rick L.
Westerman James

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial**

distribution on infiltration and runoff:

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**
-

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant:

Sub-dominant:

Other:

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
-

14. **Average percent litter cover (%) and depth (in):**
-

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**
-

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**
-

17. **Perennial plant reproductive capability:**
-